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EXTENDED-AERATION SEWAGE TREATMENT: A PRELIMINARY EVALUATION

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

1960

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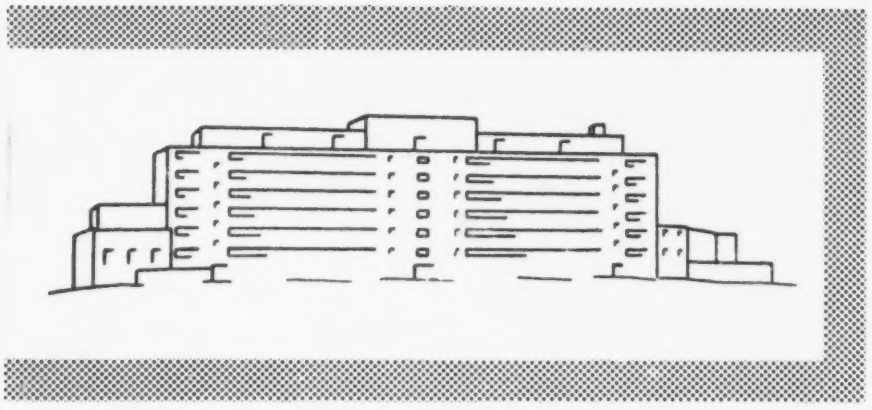
EXTENDED-AERATION SEWAGE TREATMENT

A Preliminary Evaluation



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U. S. DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE
Public Health Service

EXTENDED-AERATION SEWAGE TREATMENT

A Preliminary Evaluation

WASTE TREATMENT STUDIES
Ralph Porges, In Charge
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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of State Services
Division of Water Supply and Pollution Control

Robert A. Taft Sanitary Engineering Center
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1960

I

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The objectives of this study were guided by the requests by the Conference of State Sanitary Engineers and the Great Lakes - Upper Mississippi River Board of Sanitary Engineers.

Special recognition is made of the support, cooperation, and advice offered by: James B. Coulter, Chief, Water Project Section, Technical Services Branch, Washington, D. C.; Malcolm C. Hope, Chief, General Engineering Program, Public Health Service, Washington, D. C.; Warren F. Smith, Senior Sanitary Engineer, Division of Engineering Services, Washington, D. C.; and Harvey F. Ludwig, Consulting Engineer, Engineering Science, Inc., Pasadena, California.

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SUMMARY

The recent rapid development of population in the suburbs has outrun existing metropolitan sewerage systems, necessitating the installation of many small sewage treatment plants to serve schools, shopping areas, housing developments, and other isolated facilities. One type of small plant used for this purpose is a modification of the activated sludge process that provides for aerobic sludge digestion within the system by "extended aeration."

At the request of various States and State-sponsored groups, the Public Health Service initiated a project to evaluate the experience of the States with such plants and to collect and review available data and performance records. This study was limited to plants of 20 to 2,500 population equivalent utilizing the extended-aeration process.

The survey of 50 states revealed that use of small extended-aeration sewage treatment plants is increasing. There were 1,224 plants reported in service or under construction as of July 1, 1960. Only four States, New Hampshire, New Mexico, Nevada and North Dakota, reported no plants in use; while six States, Ohio, Pennsylvania, Louisiana, Kentucky, Illinois, and Indiana, reported 849 or approximately 70 per cent of the total.

Approximately 14 per cent of the small extended-aeration sewage treatment plants were used at housing developments where long-range loadings are difficult to predict and where growth patterns may indicate a need for temporary facilities until larger regional sewerage systems are constructed. The remaining 86 per cent of the 1,224 plants served schools, motels, industries, and similar establishments having a relatively fixed and predictable loading pattern. Reports from 73 plants describing the receiving stream indicated that 31 per cent discharged to normally dry stream beds.

Laboratory data from 59 of the 1,224 plants form the basis of the performance evaluation. Extended-aeration plants with proper design, maintenance, and operation can effect high BOD reductions. Records show a wide range of efficiencies from 33.3 to 99.3 per cent, with an average of 86 per cent BOD removal. Suspended solids removal is less, averaging 62 per cent and ranging from 0 to 96.5 per cent.

The extended-aeration process has been attractive for small sewage treatment plants because of its compactness and simplicity, obtained by eliminating primary settling and anaerobic sludge digestion, which also affords less opportunity for development of odor and insect nuisances. These plants are adaptable to small sites and to architectural treatment especially important for service at establishments such as motels, schools, and shopping centers.

Common design requirements are 24-hour aeration, 4-hour secondary settling, and a BOD loading of 15 pounds per day or less per 1,000 cubic feet of aeration tank capacity.

Meager cost data indicate that first costs range from $0.66 to $2.77 per gallon per daily design flow. Power costs approximate $111.00 per million gallons of sewage treated.

Man-hours for maintenance and operation averaged 13 per week, ranging between 1 and 47 man-hours per week.

Considerable uncertainty exists concerning the fate of the aerobically digested sludge and the need for sludge wasting facilities to assure a high removal of BOD and suspended solids. Several States require sludge holding tanks or supplemental facilities such as sand filters or stabilization ponds to maintain high effluent quality.

In an effort to insure efficient and reliable operation of such facilities, Florida requires the manufacturers to post a performance bond. Texas limits approval to plants that have local personnel and other resources necessary to supply operation and maintenance services.

The small extended-aeration sewage treatment plant is another tool in the hands of competent engineering services to provide an answer to our growing sewage treatment needs in suburban areas.

EXTENDED-AERATION SEWAGE TREATMENT

A Preliminary Evaluation

INTRODUCTION

In recent years a nation-wide population upsurge has been accompanied by an extensive development of suburbs. The building of housing developments, shopping centers, motels, schools, and other services has greatly exceeded the construction of interceptor sewers to central metropolitan sewage treatment works. As a result both interim and permanent isolated sewerage facilities have become necessary.

Progress in development of sanitary sewerage systems usually dictates the desirability of a few large sewage treatment plants rather than many small plants. In fact, one measure of public health progress is the consolidation of individual services into a community system that lends itself to effective maintenance, supervision, and control.

The installation of sewers on an area basis, as opposed to the individual homesite disposal system, requires installation of a sewage treatment plant to serve the area. Small plants for such service generally must provide an assured high degree of treatment, as dictated by requirements for the receiving watercourse, and must be economical to build and fairly automatic in operation to reduce labor costs.

There have been many attempts to solve the sewage treatment problems for small community groupings. Septic tanks with subsequent subsurface disposal, gravel beds or sand filters, have been utilized in many instances with success depending upon soil characteristics and other factors.

Waste stabilization ponds have been used effectively for interim and permanent waste treatment where suitable land is available for the acreage required. Isolation of the facility seems desirable, but current experience places less importance on this. (1)

Conventional types of waste treatment plants also have been designed for small installations and have proven satisfactory in many instances.

Although all of these processes have performed satisfactorily in many locations, efforts have continued toward developing improved treatment methods that will be more universally adaptable to the suburban areas.

Extended aeration is of interest as another process being used in this field. From a few plants ten years ago there are now many hundreds of these plants in operation. The rapidity of this growth has out-distanced orderly compilation of data concerning their applicability and effectiveness. At the same time, increasing State attention has stimulated requests by the Conference of State Sanitary Engineers and the Great Lakes - Upper Mississippi River Board of Sanitary Engineers to the Public Health Service for an evaluation of small sewage treatment plants. This report presents the initial effort of the Public Health Service to compile recent data on the extended-aeration type plants and to arrive at preliminary evaluations of their effectiveness and the magnitude of their use in the United States.

DEVELOPMENT OF EXTENDED-AERATION

There have been numerous modifications of the basic activated sludge process, such as tapered aeration, step aeration, stage aeration, and modified aeration. The extended-aeration concept of activated sludge is yet another modification which is gaining favor in the smaller plants.

Many investigators have noted that with long-term aeration of sewage the total sludge volume volume is reduced. (2, 3, 4, 5, 6, 7) This method may be used also on industrial wastes amenable to biological treatment. An extensive study of long oxidation periods for dairy wastes was made by the Eastern Regional Research Laboratory of the Department of Agriculture. A summary report (8) has been published covering studies dating back to about 1948. Treatment of dairy waste utilized an aeration tank followed by a secondary settling unit with complete return of the settleable solids to the aeration unit.

This, in essence, was treatment by aerobic stabilization of this industrial waste.

In 1947 the underloaded conventional activated sludge plant at East Palestine, Ohio (9) was operated with 100 per cent return of final settling tank sludge to the aeration tanks with no sludge wasted. An excellent plant effluent was produced. In 1950 three aerobic digestion plants based on the East Palestine experience were installed for treatment of milk wastes in Ohio. Then in 1951 the Ohio State Department of Health approved the first plant of this type for treatment of sanitary sewage from an industry. In 1952 two plants were installed to treat domestic and cafeteria wastes. These were followed in 1953 by the installation of two plants to serve schools. Since their early use in Ohio and other states, extended-aeration plants have accelerated greatly in interest and development.

The application of the extended-aeration process to sewage generally follows the principles of activated sludge treatment. An aeration tank providing for many hours detention is followed by a settling tank of several hours detention for the separation of liquid and sludge. The supernatant liquor is discharged as plant effluent, and the settled sludge is returned to the aeration unit. The concept envisages the stabilization of organic matter under aerobic conditions, with disposal of the end products into the air as gases and by passage in finely suspended or soluble form in the effluent liquid (See Flow Diagram, Figure 1).

In the extended-aeration system the conventional activated sludge process is simplified by elimination of the primary settling tank and the anaerobic sludge digestion unit. Construction also is simplified and the difficult sludge handling problem minimized by a reduction in the quantity of sludge accumulated for disposal.

Further modifications of the basic concept of the extended-aeration process have already developed in some plant designs, such as the use of a sludge holding tank to facilitate removal of excess solids to improve plant effluent quality. Supplemental units, such as sand filters or stabilization ponds, have been added in others to assure withholding of suspended matter from the final effluent and so provide maximum protection of the receiving watercourse.

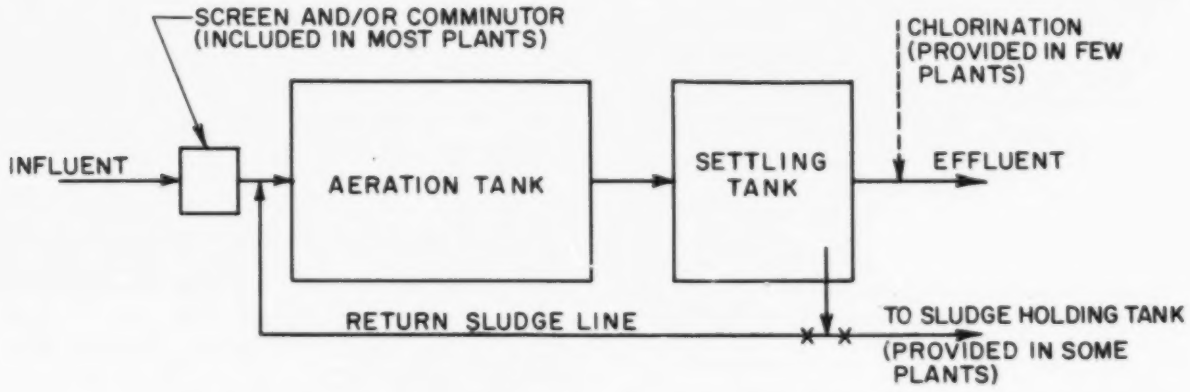

Figure 1. FLOW DIAGRAM: EXTENDED-AERATION SEWAGE TREATMENT PROCESS

OBJECTIVES

The objective of the investigation was to evaluate the experience of the States in the use and performance of the extended-aeration process as applied to the small sewage treatment plant in the capacity range from 20 to 2,500 population equivalents. The evaluation was based on existing data as the time available was insufficient for special testing of plants or experiments with the process by the study staff.

The plan of investigation included the following:

1. Determination of magnitude of present use and types of facilities served by these plants.
2. Legal requirements of State regulatory agencies and opinions and recommendations of State Sanitary Engineers.
3. Opinions of individuals having responsibility and experience with these plants.
4. Evaluation of plant operation, maintenance, laboratory analyses, and other available data.

METHOD

Two Public Health Service inventories (10, 11) were reviewed to determine the number and location of small extended-aeration treatment plants in existence in years prior to 1957.

Regional Offices of the Public Health Service were asked to obtain from each of the 50 States data on the current number of plants, installations served, laboratory records of performance, State requirements, State experiences and opinions, and any other available data.

In eleven States having many plants, staff members of this project visited installations to obtain additional data and information from plant operators, to observe on-site plant operation, and to discuss the various features of the extended-aeration plants. Samples of data collection forms are presented in Appendixes C and D.

Treatment plant manufacturers were asked to provide bulletins concerning their respective treatment units and the number of such plants in operation.

These data were tabulated and summarized to form the basis of this report.

PRESENTATION OF DATA

The Public Health Service 1945 Inventory of Water and Sewage Facilities of the United States (10) records 156 small activated sludge plants and 9 small contact aeration plants. A similar inventory (11) for 1957 lists 305 small activated sludge plants and 60 small contact aeration plants. The 1945 and 1957 inventories did not include a category for extended-aeration plants. However, by listing the small activated sludge plants that did not have primary settling and separate sludge digestion, it was concluded that 62 or more of the 305 activated sludge plants recorded in the 1957 inventory were of the extended-aeration type. These data are tabulated in Table I.

Data obtained from the States in this study show that as of July 1, 1960, there were 1,224 small extended-aeration plants in service or under construction, distributed geographically as illustrated in Figure 2.

The installations served were as follows:

Schools	393
Miscellaneous uses*	169
Housing developments	168
Industries	148
Motels and trailer parks	121
Communities	111
Institutions	67
Shopping centers	47
	1,224

*Military base, State park, country club, toll road facilities, etc.

TABLE 1. DEVELOPMENT OF SMALL SEWAGE TREATMENT PLANTS USING AERATION, 1945-1960

State	PHS Inventory 1945		PHS Inventory 1957			PHS-SEC Survey 1960
	Contact Aeration	Activated Sludge	Contact Aeration	Activated Sludge	Extended Aeration	Extended Aeration
Alabama			1			13
Arizona					1	2
Arkansas						3
California		4		7	2	17
Colorado						5
Connecticut		1		1		3
Delaware						3
Florida				8	1	38
Georgia						2
Idaho					1	1
Illinois		29	1	31	3	81
Indiana		4		28	5	71
Iowa		2				3
Kansas		2	3	3		1
Kentucky		1		1	10	86
Louisiana		4		4		96
Maine						2
Maryland				1		1
Massachusetts						19
Michigan		9		8	1	6
Minnesota		12		13	2	18
Mississippi		2		2		12
Missouri		12		17	1	12
Montana				1	4	5
Nebraska		22		18	21	22
Nevada		1	3			0
New Hampshire						0
New Jersey		2	23	2		38
New Mexico						0
New York		1		1		23
North Carolina	1	1		3		9
North Dakota						0
Ohio		13		27	2	399
Oklahoma		1		4		3
Oregon		2		6	1	15
Pennsylvania		3		3	1	116
Rhode Island					1	4
South Carolina		2		6		9
South Dakota					1	1
Tennessee		2		3		25
Texas	6	2	24	14	1	17
Utah				1		3
Vermont						2
Virginia	2		5	2	1	5
Washington		4		7		5
West Virginia						11
Wisconsin		18		21	2	8
Wyoming						4
Alaska						2
Hawaii						3
TOTALS	9	156	60	243	62	1224

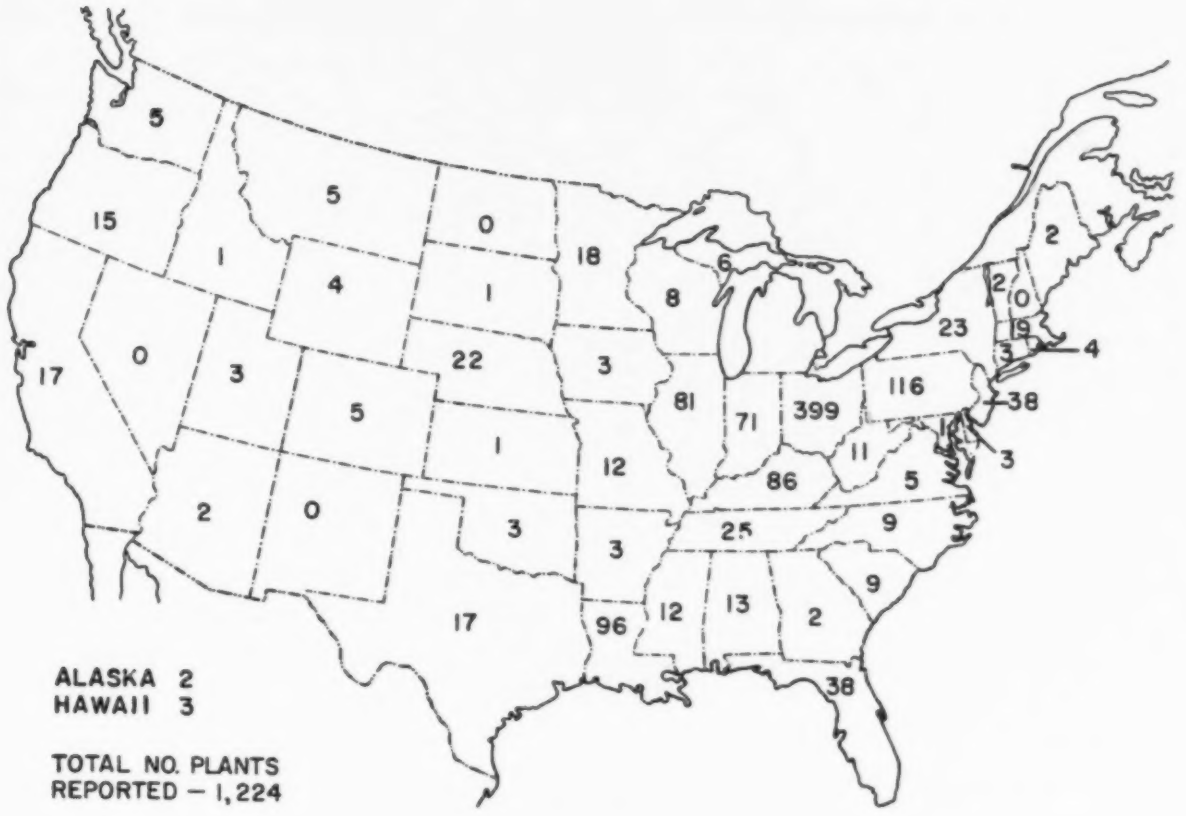

Figure 2. EXTENDED-AERATION-TYPE SMALL SEWAGE TREATMENT PLANTS, BY STATES. (1960 Survey)

The small extended-aeration sewage treatment plant is receiving wide acceptance as noted by the rapid growth in the number of installed plants. Manufacturers' records indicate that the number of plants in use today exceeds the 1,224 reported by the States by approximately 100. Plans for certain installations on Federal, State or school properties in several states may not be formally processed through the State reviewing agency and therefore do not appear in official records.

Extended-aeration plants have been used primarily to serve installations where sewage volumes are small. For example, Ohio data [12] indicates 50 per cent of the 399 small plants reported are in the 2,000 to 10,000 gallon range; 64 per cent are in the 2,000 to 15,000 gallon range (Figure 3).

LABORATORY DATA

The laboratory data received for tabulation and study were insufficient for complete analysis of the problem, yet certain trends may be detected.

Results of laboratory analyses of composited wastes received from 59 plants are tabulated in Appendix A and summarized in Table II. Composite samples from individual plants ranged from 1 to 37 in number as shown below:

No. of Composite Samples	1	2	3	4	5	6	7	10	13	14	17	24	25	26	27	37
No. of Plants	21	12	4	4	1	4	1	1	2	2	2	1	1	1	1	1

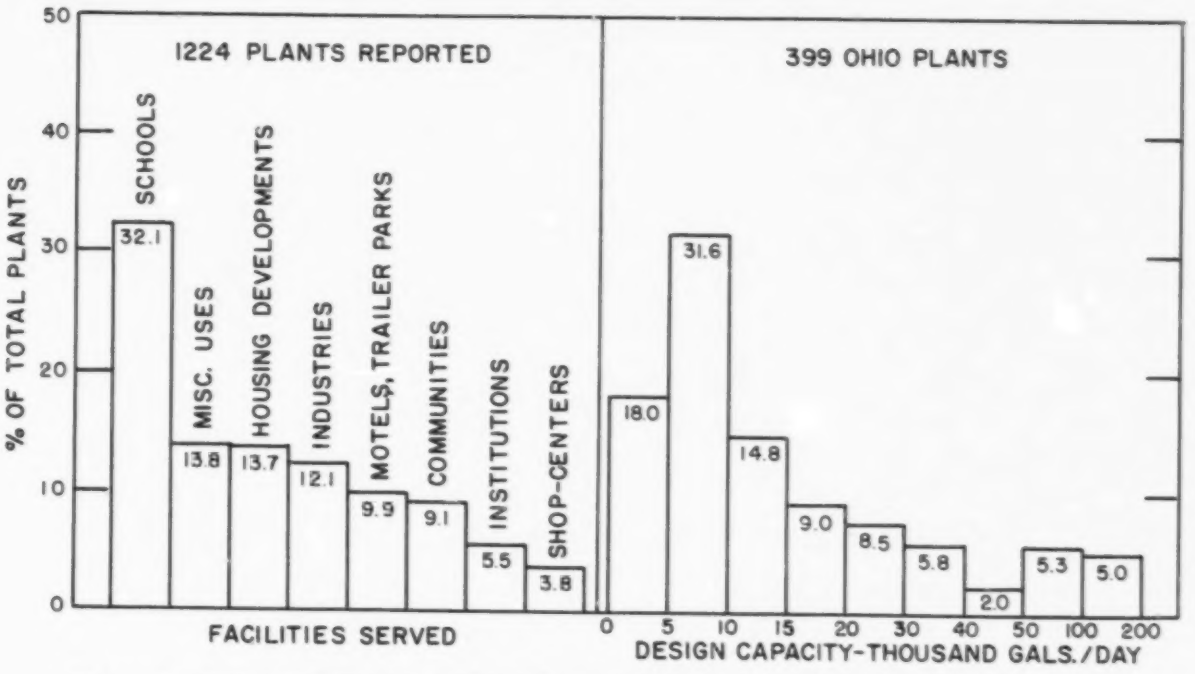

Figure 3. USE AND SIZE OF EXTENDED-AERATION SEWAGE TREATMENT PLANTS, JULY 1, 1960

TABLE 2. SUMMARY OF RESULTS OBTAINED FROM LABORATORY ANALYSES: EXTENDED-AERATION PLANTS

Type of facility served	No.	Design flow range (gpd)	No.	Actual flow per cent of design		5-Day BOD removals, average	Suspended solids removals, average
				Range	Avg.		
Schools	18	4,700 - 63,000	15	20.3 - 103.7	39.6	87.1	60.3
Housing Developments	7	15,000 - 100,000	7	16.8 - 105.0	57.3	91.6	69.4
Industry	7	6,900 - 100,000	6	31.2 - 131.5	79.7	88.1	62.7
Community	5	15,000 - 120,000	5	28.3 - 115.3	69.6	89.2	76.2
Institution	3	7,000 - 40,000	3	66.3 - 128.6	91.8	94.7	83.2
Motels, Trailer Parks	6	2,500 - 25,000	4	38.7 - 152.0	81.7	74.9	46.5
Shopping Center	8	12,000 - 100,000	8	20.0 - 145.6	78.0	94.0	65.9
Miscellaneous	5	8,500 - 21,400	2	24.4 - 38.8	31.6	75.5	43.1
	59		50				
		Average of total plants (59)				87.0	62.1
		Median of total plants				91.6	73.0
		Maximum of total plants				99.3	96.5
		Minimum of total plants				33.3	00.0

The duration of collection varied from 3 to 24 hours. Available information on mixed liquor, suspended solids, sludge volume index, and most probable number of coliform organisms as determined by grab samples is listed. Total daily flows during the periods of sampling, and plant design flows were available from most of the 59 plants reporting laboratory data.

The data used from 49 plants were from state laboratories and data from 10 plants were from county and university laboratories. The types of facilities served by these plants are shown in Table 2.

The 59 extended-aeration plants taken as a group provided an average 5-day 20°C BOD removal of 87.0 per cent with a median of 91.6 per cent. Maximum and minimum BOD removals were 99.3 and 33.3 per cent respectively. The suspended solids removals were calculated to average 82.1 per cent with a median of 73.0 per cent. A maximum daily suspended solids removal of 96.5 per cent was reported by one plant, whereas in six plants the suspended solids content of the effluent remained essentially the same as the raw sewage or increased to a concentration higher than the raw sewage.

It has been observed (7) that even though the total and volatile solids in the effluent may be high, the BOD is frequently low, and the immediate effect of these suspended solids on the receiving watercourse may be minor. Possible effects of these discharges should be given consideration where the dilution ratio is minimal or the receiving watercourse is normally dry.

These results indicate the effective range of treatment of sewage by extended-aeration plants from which laboratory data were available. Presumably these plants received better than average care in operation and maintenance. Therefore, their performance in BOD and suspended solids removal is probably higher than would be obtained from a group of plants selected at random.

Information obtained from 69 extended-aeration plants visited by the staff indicated that 24 plants had no laboratory facilities, whereas 23 plants had on site laboratories, and 22 plants had off site laboratory facilities available.

HYDRAULIC AND ORGANIC LOADING

Of the 49 plants for which actual flow data were presented, 38 carried a daily flow less than their design flow. The hydraulic loading is important because BOD and suspended solids removal efficiencies obtained for any plant at hydraulic underload may not be representative of results at design flow. Hasbrouck (12) of the Ohio Department of Health considers both the hydraulic and organic loading and says, "We've noted that our plants will work very well when underloaded and that whatever the applied load is, the units will attempt to reach a point of equilibrium. The closer the BOD loading approaches one pound per six hundred gallons of aeration tank capacity, the more difficult it is to keep the sludge in the final settling tank." One pound of BOD per six hundred gallons is equivalent to 12.5 pounds per 1,000 cubic feet of aeration volume. The BOD loadings received by the 49 plants averaged 15 pounds per 1000 cubic feet of aeration tank volume when operating at an average of 60 per cent of design flow.

INITIAL PLANT COSTS

Data on initial estimated construction costs were obtained for 47 plants. The information received (Table 3) is not adequate for purposes of a rigorous cost analysis since most of the data consist of engineering estimates and bid prices rather than actual costs. All of the information contains a number of unknowns or atypical factors.* Cost values were adjusted to June 1960 on the basis of the Engineering News Record construction cost index. These data do not include the cost of sewers, lift stations, or associated engineering, legal, and administrative expenses. For 19 housing developments and communities, additional information regarding the initial estimated cost per house served is presented in Table 3.

Four plants listed initial cost data on lift stations. Construction of lift stations at three of these plants amounted to $0.06 to $0.13 per gallon of daily design flow. The other plant reported and estimate of $0.53 per gallon of design flow.

*For example, in one plant a flotation unit was installed ahead of the aeration tank.

TABLE 3. INITIAL COSTS OF EXTENDED-

Plant No.	Location	Type Facility Served	Design Flow (daily) 1,000 gpd	Plant Cost $1,000[1]	Year[2]
1	Ohio	Ho. Development	100.0	80.0	1958
2	Ohio	Ho. Development	40.0	45.0	1958
3	Ohio	Ho. Development	15.0	15.0	1958
4	Ohio	Ho. Development	50.0	54.0	1959
5	Pa.	Industry	100.0	85.0	1954
6	Pa.	Ho. Development	33.0	50.35	1959
7	Pa.	Tourist***	13.6	35.0	1959
8	Pa.	Community	80.0	53.36	1960
9	Nebr.	Community	40.0	32.69	1960
10	Nebr.	Community	25.0	26.9B	1960
11	Nebr.	Community	44.0	26.9B	1960
12	Wisc.	Community	60.0	56.49EE	1958
13	Wisc.	Ho. Development	60.0	54.23EE	1958
14	Ill.	Ho. Development	150.0	121.0	1957
15	Ky.	School	8.9	16.65	1955
16	Ky.	Ho. Development	100.0	72.48	1956
17	Ky.	Ho. Development	175.6	96.36	1956
18	N. J.	Institution	30.0e	30.0EE	1951
19	N. J.	School	60.0	55.0EE	1956
20	N. J.	School	40.0	35.0EE	1957
21	N. J.	School	18.0	42.0EE	1958
22	N. J.	Industry	40.0	45.0EE	1958
23	N. J.	Shopping Center	50.0	45.0EE	1958
24	N. J.	School	6.0	25.0EE	1959
25	N. J.	Industry	20.0	28.0EE	1959
26(13)	Fla.	Shopping Center	19.5	45.0	1956
27	Fla.	Tourist***	3.0	7.2	1960
28	Fla.	Tourist***	15.0	22.0e	1958
29	Fla.	Tourist***	5.0*	4.3EE	1958
	Fla.	Tourist***	6.5**	6.3EE	1960
30	Fla.	Tourist***	16.2	10.0EE	1959
31	Fla.	Tourist***	20.0	42.0	1960
32	Fla.	Tourist***	25.0	25.0EE	1958
33	Fla.	Tourist***	16.5	20.0	1958
34	Fla.	Tourist***	15.0	15.0EE	1959
35	Fla.	Shopping Center	40.0	35.0EE	1959
36	Fla.	Shopping Center	60.0	54.0EE	1960
37	Fla.	Shopping Center	100.0	85.0EE	1958
38	Fla.	Shopping Center	30.0	36.0EE	1959
39	Fla.	School	24.0	24.3	1959
40	Fla.	Industry	37.6*	65.0	1957
	Fla.	Industry	7.5**	18.0EE	1959
41	Fla.	Institution	20.0	28.5	1958
42	Fla.	Unknown	6.2	15.2EE	1960
43(14)	Texas	Ho. Development	250.0e	67.91	1954-56
44	Texas	Community	30.0	48.00	1960
45(14)	Ind.	Ho. Development	85.0e	70.0	1955
46(14)	Ind.	Ho. Development	40.0e	31.99	1956
47(14)	Calif.	Ho. Development	235.0e	130.0	1951-55

1 At time of construction or engineering estimate.
2 Year during which cost figures were developed.
3 Cost adjusted to June 1960.
* Unit No. 1.
** Unit No. 2.
*** Motels, trailer parks, etc.

AERATION TREATMENT PLANTS

Plant Cost $1,000 (adjusted)[3]	Preseat No. Houses Served	Design No. Houses Served	Cost[3] per Gal. Design Flow	Cost[3] per House (design no.)	Sludge Holding Facilities
86.96	265	265	0.87	328	No
48.92	165	165	1.22	296	No
16.31	30	30	1.09	544	No
55.78	40	100	1.12	558	No
111.69	NA	NA	1.12	NA	No
52.01	-	95e	1.58	547e	Yes
36.16	NA	NA	2.66	NA	Yes
53.36	153	200	0.67	267	No
32.69	-	115e	0.82	284e	-
26.90	-	70e	1.08E	384e(B)	-
26.90	125e	157e	0.61B	171e(B)	-
61.40EE	65e	170e	1.02EE	361(EE)	Yes
58.95EE	93	163	0.98EE	362(EE)	Yes
137.94	249e	485e	0.92	284e	Yes
20.83	NA	NA	2.34	NA	No
86.98	146	270	0.87	322	Yes
115.63	469	650e	0.66	178e	Yes
45.60EE	NA	NA	1.52EE	NA	Yes
66.00EE	NA	NA	1.10EE	NA	-
39.90EE	NA	NA	1.00EE	NA	-
45.65EE	NA	NA	2.54EE	NA	-
48.92EE	NA	NA	1.22EE	NA	Yes
48.92EE	NA	NA	0.98EE	NA	Yes
25.83EE	NA	NA	4.31EE	NA	-
28.92EE	NA	NA	1.45EE	NA	Yes
54.00	NA	NA	2.77	NA	Yes
7.2	NA	NA	2.40	NA	Yes
23.91e	NA	NA	1.59e	NA	Yes
4.67EE	NA	NA	0.93EE	NA	Yes
6.3EE	NA	NA	0.97EE	NA	Yes
10.33EE	NA	NA	0.64EE	NA	-
42.0	NA	NA	2.10	NA	Yes
27.18EE	NA	NA	1.09EE	NA	Yes
21.74	NA	NA	1.32	NA	Yes
15.50EE	NA	NA	1.03EE	NA	Yes
36.16EE	NA	NA	0.90EE	NA	Yes
54.0EE	NA	NA	0.90EE	NA	Yes
92.40EE	NA	NA	0.92EE	NA	Yes
37.19EE	NA	NA	1.24EE	NA	Yes
25.10	NA	NA	1.05	NA	No
74.10	NA	NA	1.97	NA	Yes
18.59EE	NA	NA	2.48EE	NA	Yes
30.98	NA	NA	1.55	NA	No
15.2EE	-	-	2.45EE	NA	No
85.23	-	675	0.34e	126e	No
48.00	80e	137e	1.60	350e	-
87.57	-	222	1.03e	394	No
38.39	-	110	0.96e	349	No
179.66e	-	625	0.76e	287e	No

NA Not applicable.
EE Engineering estimate.
B Bid price.
e Estimated.
(13) Reference 13.
(14) Reference 14.

Final construction cost data were obtained for 13 plants with design flows less than 40,000 gallons per day (gpd). The construction cost ranged from $1.05 to $2.77 per gallon of daily design flow.

There are indications that the cost for plants in the range of 40,000 to 90,000 gpd design flow will approximate $1.00 per gallon. Larger plants will probably show decreasing unit costs per gallon with increased design flow.

POWER COSTS

Power cost data were difficult to obtain, as electric power meters were seldom provided whereby plant power consumption could be measured separately from other facilities. However, the data do suggest that power costs for these plants are probably quite high in comparison to those of small conventional secondary treatment installations.

Power cost data for 14 extended-aeration plants are presented in Table 4. The information shown does not include costs for lift station operation and therefore typifies the power utilized for treatment alone. Cost data for the plants studied were based on two days to two years of continuous operation. Where the data are reported only in kilowatt hours a rate of $0.02 per kilowatt hour was used to compute costs.

TABLE 4. POWER COSTS OF EXTENDED-AERATION PLANTS

Plant No.	Location	Type of service	Daily flow in-1,000 gpd		Annual power cost	Cost/m.g. actual flow$_e$
			Design	Actual		
1	Ohio	Ho. Development	160.0	45.0	$2060	$125.40
2	Ohio	Ho. Development	40.0	40.0	$1260	$ 87.50
3	Ohio	Ho. Development	100.0	30.0	$ 794	$ 72.50
4	Ohio	Ho. Development	15.0	10.0	$ 769	$207.80
5	Pa.	Motels, Trailer Parks	100.0	32.5	$1546	$130.40
6	Pa.	Community	80.0	50.0	$2000e	$109.60
7	Pa.	Industry	100.0	70.0	$3000e*	$117.50
8	Ill.	Ho. Development	150.0	85.0	$ 840	$ 27.10
9	Ky.	Ho. Development	100.0	32.0	$1950	$167.00
10	Ky.	Ho. Development	175.6	103.0	$2850**	$ 75.80
11	Fla.	Shopping Center	12.0	14.7	$ 526	$ 98.00
12	Fla.	Motels, Trailer Parks	25.0	12.0	$ 720e	$164.40
13	Fla.	Shopping Center	30.0	20.0	$ 720e	$ 98.60
14 (15)	Calif.	Community	47.5	24.0	$ 660	$ 75.30
		Average			$1410	$111.20
		Median			$1050	$104.10
		Maximum			$3000e	$207.80
		Minimum			$ 526	$ 27.10

e Estimated.
* This plant utilizes excessive quantities of air.
** Includes power necessary for lifting approximately 10 per cent of total incoming sewage flow to the plant.
(15) Reference 15.

The average plant power cost reported for 14 extended aeration plants, excluding lift stations, approximate $1,410 per year. Power costs in terms of a unit volume of flow indicated average and median costs of $111.20 and $104.10, respectively, for each million gallons of actual waste treated.

OPERATOR MAN-HOURS PER WEEK

The amount of operation and maintenance attention given small extended-aeration plants averaged 12.7 man hours per week, based on information from 52 plants. The time range for these plants was 1 to 47 man hours per week. The 52 plants reporting operator time are classified as follows:

No. plants	Capacity in gpd, average	Facility	Man-hrs/wk., average
19	80,000	Housing Developments	17.7
11	15,000	Motels, Trailer Parks	8.4
7	40,000	Shopping Centers	16.7
4	27,000	Institutions	8.0
9	11,000	Schools	4.2
2	72,000	Industry	22.0

The maintenance and operation data represent existing conditions and do not necessarily represent the amount of maintenance and operation required. The figures probably are good indicators of the amount of time being spent to obtain results satisfactory to the owners. They support the general impression obtained from operators that these plants need daily attention of one or two hours plus additional time for overhauling and replacement of equipment. Because of inadequate attention approximately 10 per cent of the plants visited were by-passing raw sewage and many more were giving obviously poor performance.

LOCATION OF PLANTS

Information was obtained from 58 plants on the distance between the treatment plant and the nearest establishment or dwelling. These results are summarized as follows:

Facility served	No.	Distance between sewage treatment plant and nearest dwelling or establishment, (ft.)			
		Min.	Max.	Avg.	Median
Schools	3	300	1980	910	450
Housing Developments	22	200	2840	736	500
Industry	5	20	2640	1062	1000
Institutions	5	200	1320	704	500
Tourist Facilities	17	0	1320	318	150
Shopping Centers	6	10	600	318	300

These data indicate the variability of plant location. For various reasons, such as topography, type of facility served, land costs, outfall sewer costs, plant design, and type of receiving stream, many plants are constructed in remote locations, while others have been constructed in close proximity to inhabited areas without noticeable odor nuisance. One such plant was built with the side walls completely above ground level and located in a large parking lot serving a shopping center. Another plant located near a swimming pool at a luxurious motel was landscaped from view and caused no noticeable odor. Conversely, the prevalence of objectionable odors from a plant located in the basement of a building indicated that sewage treatment plants should be located in areas outside of inbabited buildings. The noise from operation of mechanical equipment should also be considered in selection of a plant site.

STATE REQUIREMENTS

Several states have set up specific requirements and design standards based on past performance, manufacturers suggestions, and engineering judgment. Many states do not have detailed standards but are guided by the standards of other states or consider each project on its own merits. The majority of states require the ownership and the responsibility for operation and maintenance of sewage treatment plants to be placed in an official body or legal entity, such as sewer districts, municipalities, and tax supported agencies. Private trusts, companies, or corporations may satisfy the "official body" requirement when licensed by the State Utilities Commission.

The following are a summary of the important design requirements which are presented more completely in Appendix B.

Comminutors and Screens

Five states require comminutors and one requires both comminutors and bar screens for all extended-aeration plants. Ohio and 7 other states that follow Ohio design criteria require a comminutor for all extended-aeration plants designed for daily flows in excess of 40,000 gpd. For the smaller plants comminutors are recommended; if comminutors are not used, bar screens are required. These 14 states were the only ones reporting information on the use of comminutors or screens.

Aeration Unit

Fourteen states reported design requirements or recommendations on the aeration unit, most commonly specifying 24 hours aeration time based on average daily flow. One state requires 30 hours aeration time based on average daily sewage flow.

Other aeration unit design criteria were mentioned as follows: cubic feet of air per pound of applied BOD varied from 1,500 to 3,500 cubic feet for diffused air installations and one state mentioned 500 cubic feet for mechanical aeration installations; single aeration tanks were limited to 37,500 to 40,000 gpd capacity in some states; and one state required that all plants be equipped with more than one air blower, whereas eight states had this requirement for plants over 20,000 gpd capacity.

Settling Tank

Fourteen states reported design requirements on the settling tank. These were specifications on detention time, surface settling and weir overflow rates, skimming devices, and sludge return rate.

A detention time of four hours based on average daily flow was most frequently mentioned. The consideration of runoff periods of 8, 12, 16, and 24 hours, depending upon the type of facility served, is used in some states to determine settling tank capacity. Surface settling rate varied from 350 to 700 gpd per sq. ft. One state limits the weir overflow rate to a maximum of 6000 gals. per day per foot. Requirements for sludge return rate varied from ratios of 1:1 to 1.5:1.

Removal of settled sludge from the settling tank and returning it to the aeration unit presents several problems. The sludge has a tendency to adhere to the sides of the settling compartment, requiring the use of scrapers or other cleaning devices. Removal of sludge from the settling tank hopper on a continuous or intermittent basis is an important consideration of operation. The quantity of sludge returned will have an effect on settling tank detention time and weir overflow rates.

Sludge Holding Tank

Eleven states reported that sludge holding tanks were required or requested in the plant design. The tank design capacity ranged from 2 to 8 cubic feet per capita.

Considerable difference of opinion exists concerning the need for wasting of excess activated sludge. It is generally agreed, however, that wasting of excess sludge will improve effluent quality.

A 1960 report by Engineering-Science, Inc. (16) states: "If an exceptionally high degree of treatment in terms of suspended solids is required, a sludge holding tank should be incorporated in the design."

There is evidence (17) that equilibrium may not be reached and that some sludge will pass out in the effluent unless removed from the system. If sludge wasting is required, then facilities such as sludge holding tanks and methods of sludge disposal must be provided.

Some control is desirable over the ultimate disposal of the sludge after it is trucked from the plant. The question constantly comes to mind, "Where do they put it"? In Dade County, Florida, a commercial plant was constructed to handle this type of sludge and materials from septic tanks or other sewage treatment installations. The sludge was given an additional seven days digestion under anaerobic conditions, following which it was dewatered on sand beds. This concept of a special plant for handling of sludge is one solution to the sludge disposal problem for a group of small sewage treatment plants.

The volume of sludge to be removed from any given plant cannot be determined from the data used in this report. However, from one plant treating 100,000 gpd of sewage the operator

wasted 3,000 gallons of sludge per month which was hauled from the plant in two increments of 1,500 gallons each.

The present study cannot properly evaluate the role that sludge holding tanks play in overall treatment, but the specific information thus far obtained from State Health Departments and from special studies on particular types of extended-aeration plants is worthy of note.

The Ohio Department of Health recommends sludge holding tanks when mechanical aerators are used. Although sludge holding tanks are not required in those plants where aeration is by diffused air from blowers, they are recommended as possibly advantageous to efficient operation. The State of Kentucky requires sludge storage where flows are greater than 50,000 gpd, whereas Indiana requires it where flows are greater than 100,000 gpd. Wisconsin requires sludge holding tanks in all plants, and Illinois specifies that storage shall be used where necessary or desirable. Seven states are guided by Ohio design criteria for extended-aeration plants and presumably adhere to Ohio requirements on sludge holding. The remaining states did not express any views on the subject.

Some states as reported below regard stabilization ponds or sand filters as sufficient control to prevent excess solids from reaching a watercourse. In such plants sludge holding tanks and frequent wastage of sludge are probably not necessary.

Supplement Treatment

Chlorination is stated as a possible requirement by 16 states, with one state specifying an unequivocal chlorination requirement.

There were six states requiring additional treatment in the form of a stabilization pond or a sand filter. Three states required a stabilization pond, two required a sand filter, and one required either a pond or a filter.

Of 73 plants that reported on the type of receiving watercourse, 23 were discharging to dry ditches and 50 to all weather watercourses.

MISCELLANEOUS

The rapid growth of small sewage treatment plants is placing an enormous burden on regulatory agencies. To ensure full time effective operation there should be frequent routine inspection of all small plants. The 1,224 extended aeration plants and many other small conventional plants impose a tremendous field inspection load.

It is accepted that the small sewage treatment plant is usually operated by nontechnical personnel. There is need for the development or adaptation of simple laboratory tests and for intensive instruction programs to train the small treatment plant operators in the use of techniques adaptable to small plant control. It was reported (18) from one plant that the operator utilized the concentration of DO in the final effluent as an indicator for the control of solids in the aeration tank. When the DO in the effluent dropped below that usually present, solids in the aeration tank were wasted until the desired effluent DO level was re-established. By this method a consistently good effluent was discharged from the plant. The use of a centrifuge to approximate solids concentrations in the mixed liquor and plant effluent can be of advantage in operating extended-aeration plants. A test has been used in which the mixed liquor from the aeration tank was centrifuged for five minutes and the quantity of precipitated solids were compared to previous results. After a period of experience, the plant operator can readily use this quick method of evaluating control of solids in the aeration tank.

There is limited information on removal of coliform organisms by the extended-aeration process. However, it is generally recognized (19) the activated sludge process will reduce coliform organisms by amounts exceeding 90 per cent.

Reports from several plants indicated serious interference with operation due to infiltration into the sewerage system. Excess flow caused activated solids to be swept from the plant and a high concentration of inorganic solids in the raw sewage interfered with treatment in the aeration tank.

CONCLUSIONS

1. The data on extended-aeration plants collected during this study are insufficient in both extent and detail to adequately evaluate the factors controlling construction and operational costs, design criteria, and those affecting the performance of such plants. However, certain trends in current practice can be detected.

2. Extended-aeration plants for treatment of sewage are receiving wide usage for both permanent and temporary installations. These plants can be designed and operated to produce high BOD removal efficiencies.

3. One of the outstanding operational features of extended-aeration plants is the absence of noticeable odors.

4. Considerable difference of opinion exists concerning the need for sludge wasting facilities and the attendant sludge handling and disposal problems. It is generally recognized that withdrawal of activated sludge will enhance effluent quality; therefore, the necessity for such facilities will be governed by the quality of effluent required for the particular receiving stream.

5. There is a paucity of data concerning the fate of the aerobically digested sludge as well as the significance of the relationship between the BOD, suspended and volatile solids in plant effluents, and their effect on the receiving stream.

6. Operating difficulties might be expected with plants receiving a significant proportion of laundry, restaurant, or supermarket wastes. Several States recommended that grocery stores and similar establishments be required to dispose of raw vegetable wastes by garbage collection rather than by discharge to the sanitary sewerage system.

7. Each plant should be designed so as to incorporate basic devices such as a flume and stilling well in which flow measurement equipment can be installed. In relatively large plants permanent flow measurement devices and totalizing instruments should be part of the design features. Absence of an electric power meter in most plants impaired the study of operation costs.

8. There is a wide range of opinion concerning the minimum time necessary for the operator to spend at the plant to provide proper operation and maintenance. There are certain housekeeping chores that require attendance on a daily basis. It appears that one hour per day for routine work is the absolute minimum to secure reasonable results in the smaller plants. Additional time will be necessary for plant breakdowns or emergencies. Larger plants require more time.

9. While it is realized that firm design criteria are not well established; this process, as any other sewage treatment process, requires the application of the principles of engineering evaluation.

10. Simplicity of process, predesign and flexibility of units, small site requirements, and ease of architectural treatment make these plants adaptable to many locations.

REFERENCES

1. Van Heuvelen, et al. "Waste Stabilization Lagoons - Design, Construction and Operation Practices Among Missouri Basin States," Journal Water Pollution Control Federation, 32, (September, 1960).

2. Porges, N., and Hoover, S. R. "Treatment of Dairy Wastes by Aeration." I. Methods of Study Proc. of 5th Industrial Waste Conference, Purdue University, 130-136, (November, 1949).

3. Hoover, S. R., and Porges, N. II. Continuous Aeration Studies. Proc. of 5th Industrial Waste Conference, Purdue University, 137-144 (November, 1949).

4. Jaffe, T. "Package Sewage Treatment Plants. "Water and Sewage Works Journal, 104, 8, 369 (August 1957).

5. Walker, K. H."'Package' and Compact Plants -- What Makes Them Click?" Wastes Engineering, 29, 3, 134 (March, 1958).

6. Thayer, P. M. "An Answer to Fringe Area Sanitation Problems," Proc. 8th Southern Municipal & Industrial Waste Conference, (April, 1959).

7. Knox, H. "Current Observations on Aerobic Digestion Plants in Ohio," Paper presented at the Annual Meeting of West Virginia Sewage and Industrial Waste Association, Huntington, West Virginia, (March 1960).

8. Porges, Nandor. "Dairy Wastes: Disposal by Balanced Bio-Chemical Bio-Oxidation," Dairy Engineering, (September & October, 1958).

9. Knox, H. "Progress Report on Aerobic Digestion Plants in Ohio," Paper presented at 5th Annual Waste Engineering Conference, University of Minnesota (December 12, 1958).

10. Inventory of Water & Sewage Facilities in the United States, 1945, FSA, Public Health Service, Cincinnati, Ohio, 1948.

11. 1957 Inventory Municipal & Industrial Waste Facilities, U. S. Department of Health, Education, and Welfare, PHS.

12. Hasbrouch, D. C. "Aerobic Digestion Plants in Ohio -- 1950-1960". Paper presented at the 34th Annual Ohio Sewage and Industrial Waste Treatment Conference, Columbus, Ohio (June, 1960).

13. Kiker, John E. "Package and Subdivision Sewage Treatment Plants," Journal Water Pollution Control Federation, 32, 8, (August 1960).

14. "Small Sewage Treatment Systems," National Association of Home Builders Research Institute in Cooperation with U. S. Public Health Service, 1959.

15. Ramseier, R. E. "A Consulting Engineer Weighs Complete Aerobic Treatment," Wastes Engineering, 31, 3, 142, (March, 1960).

16. Ludwig, Harvey F., et al. Engineering-Science, Inc., "Theory, Design and Operation of the Rated Aeration Waste-Water Treatment Process," Published by Chicago Pump, (1960).

17. Busch, A. W. and Myrick, N. "Food-Population Equilibria in Bench-Scale Bio-Oxidation Units." Journal of Water Pollution Control Federation, 32, 9, 949 (1960).

18. Pierce, Donald M. Personal correspondence and unpublished report on test plant at Lansing, Michigan.

19. Kabler, Paul. "Removal of Pathogenic Microorganisms by Sewage Treatment Processes." Sewage Works Journal, 31, 12 (December 1959).

APPENDIX

A. Laboratory Results, Extended Aeration Plants

B. State Policies and Comments

C. Data Collection Outline, Small Sewage Treatment Plant Study

D. Field Data Collection, Small Sewage Treatment Plants

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Type Facility Served	Plant No.	Flow - 1000 gpd		Sampling Period Dates	Composites		Laboratory					
							BOD (5) - ppm			Suspended		
		Design	Actual		No.	Duration hrs.	Raw	Effl.	% Rmvl.	Raw	Effl.	% Rmvl.
School	1	20.0	-	1/25/60	1	-	75	50	33.3	40	80	0
"	2	14.0	3.0e	4/21/60	1	9	510	110	78.4	125	150	0
"	3	60.00	20.0e	2/2/60	5	8-9	630	60	90.5	90	8	91.1
				4/14/60			280	17	93.9	160	25	84.4
				4/28/60			135	31	77.0	32	24	25.0
				5/19/60			185	25	86.5	70	22	68.6
				5/26/60			140	13	90.7	70	20	71.4
				Ave.					87.7			68.1
"	4	28.0	10.7	1959-60	26	-	318	18	94.3	216	26	88.0
"	5	10.0	2.6	1959-60	14	-	117	10	91.5	77	260Mud	0
"	6	7.5	1.8	1959-60	17	-	121	18	85.1	46	40.3	12.4
"	7	8.1	8.4	5/19/59	1	8	285	21	92.6	340	50	85.3
"	8	4.7	3.2	5/20/59	1	8	750	16	97.9	240	20	91.7
"	9	40.0	22.5	5/24-25/60	4	24	227	4.4	98.1	186	15	91.9
				6/21-22/60			156	2.2	98.6	118	14	88.1
				7/7-8/60			165	3.2	98.1	98	11	88.8
				7/28/60			242	7.0	97.1	176	6	96.6
				Ave.					98.0			91.4
"	10	63.0	12.8	9/4/57	1	-	310	4	98.7	106	58	45.3
"	11	7.5	-	4/5/57	2	-	380	78	79.5	234	80	65.8
				9/3/57			100	10	90.0	660	58	91.2
				Ave.					84.8			78.5
"	12	30.0	6.4	4/10/57	2	-	320	29	90.9	210	66	68.6
				9/3/57			390	18	95.4	296	104	64.9
				Ave.					93.2			66.8
	--	--	--	--	-	-	--	--	--	--	--	--
"	13	7.5	2.9	1/20/55	7	4-7	450	26	94.2	160	58	63.8
				1/21/55			420	43	89.8	504	86	82.9
				2/2/55			255	48	81.2	140	57	59.3
				2/4/55			260	70	73.1	148	81	45.3
				2/9/55			300	65	78.3	278	88	68.3
				2/10/55			190	40	78.9	106	94	11.3
				2/11/55			360	75	79.2	220	88	60.0
				Ave.					82.1			55.8
"	14	-	-	11/16/55	1	8	280	70	75.0	242	90	62.8
"	15	30.0	18.3	2/9/60	2	6-10	203	17	91.6	165	32	80.6
				2/10/60			245	20	91.8	194	31	84.0
				Ave.					91.7			82.3
	--	--	--	--	-	-	--	--	--	--	--	--
"	16	20.0	4.8	2/11/60	2	6-10	460	2	99.6	317	33	89.6
				2/12/60			520	5	99.0	315	23	92.7
				Ave.					99.3			91.2
"	17	7.5	2.4	2/23/60	1	6-10	247	37	85.0	332	75	77.4
"	18	11.0e	2.8	5/12/60	1	10	510	7	98.6	170	19	88.8
Housing Development	19	40.0	32.0	1959-60	25	-	231	16	93.1	238	65	72.7
"	20	100.0	41.5	1959-60	38	-	199	15	92.5	233	39	83.3
	--	--	--	--	--	-	--	--	--	--	--	--
				1/11/58	27	8	270	8.2	97.0	328	10	97.0
				2/3/58			189	14	92.6	-	-	-
				3/21/58			203	15.7	92.3	230	20	91.3
				4/14/58			170	17	90.0	326	20	93.9
				5/26/58			175	12.8	92.7	235	30	87.2
				6/30/58			176	17	90.3	240	20	91.7

(1) Grab Samples

EXTENDED-AERATION PLANTS

Analyses: Solids - ppm				S. V. L.	C. O. D. - ppm			Sludge Holding Facilities	Comments
ML SS		Ret. Sludge							
Tot.	Vol	Tot.	Vol.		Raw	Effl.	% Rmvl.		
2290	1920	2760	2320	59	205	200	2.5	-	
1390	1260	100	88	86	900	410	54.4	-	
780	660	2750	2350	120	860	170	80.2	-	
1230	1020	3220	2830	146	850	120	85.9	-	
1780	1620	5460	4940	101	160	150	6.3	-	
1700	1560	6340	5770	110	230	127	44.8	-	
1770	1700	4690	4500	107	320	82	74.4	-	
1450	1312	4492	3678	117			58.3	-	
6697	--	--	--	-	--	--	-	-	Data are ave. of 26 days
9242 Mud	--	--	--	-	--	--	-	-	Data are ave. of 14 days
4841	--	--	--	-	--	--	-	-	Data are ave. of 17 days
660	--	--	--	-	--	--	-	-	
2880	--	--	--	-	--	--	-	-	
5660	3640	--	--	-	--	--	-	Yes	
5970	3570	--	--	-	--	--	-	-	
4760	3170	--	--	-	--	--	-	-	
2640	1840	--	--	-	--	--	-	-	
4757	3055	--	--	-	--	--	-	-	
11440	3290	--	--	-	--	--	-	No	
2450	1730	--	--	-	--	--	-	Yes	
5440	2940	--	--	-	--	--	-	-	
3945	2335	--	--	-	--	--	-	-	
8140	4540	--	--	-	--	--	-	-	MPN
7290	320	--	--	-	--	--	-	-	Date / Raw / Effl.
7715	2430	--	--	-	--	--	-	-	11/1/57 / 4.3×10^8 / 2.3×10^5
--	--	--	--	-	--	--	-	-	12/18/57 / 2.3×10^7 / 9.3×10^6
--	--	--	--	-	--	--	-	Yes	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	---	--	-	--	--	-	Yes	
--	--	--	--	-	--	--	-	Yes	MPN
--	--	--	--	-	--	--	-	-	Date / Raw / Effl.
--	--	--	--	-	--	--	-	-	2/9/60 / 4.9×10^6 / 2.4×10^5
--	--	--	--	-	--	--	-	-	2/10/60 / 7.9×10^6 / 7.9×10^4
--	--	--	--	-	--	--	-	Yes	2/11/60 / 17×10^6 / 2.4×10^4
--	--	--	--	-	--	--	-	-	2/12/60 / 17×10^6 / 2.4×10^4
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	Yes	4.9×10^6 / 3.3×10^4
2700	--	--	--	-	--	--	-	Yes	
4891	--	--	--	-	--	--	-	No	Data are ave. of 25 days
6697	--	--	--	-	--	--	-	No	Data are ave. of 38 days
--	--	--	--	-	--	--	-	-	Reported by SHD
--	--	--	--	-	--	--	-	-	Data Rept. by County Hlth.
--	--	--	--	-	--	--	-	-	Dept.
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	
--	--	--	--	-	--	--	-	-	

Type Facility Served	Plant No.	Flow - 1000 gpd Design	Flow - 1000 gpd Actual	Sampling Period Dates	Composites No.	Composites Duration hrs	Laboratory BOD (5) - ppm Raw	BOD (5) - ppm Effl.	BOD (5) - ppm % Rmvl.	Laboratory Suspended Raw	Suspended Effl.	Suspended % Rmvl.
Housing Development	--	--	--	7/17/58	-	-	148	12.1	91.8	163	18	89.0
"	--	--	--	8/4/58	-	-	153	18	88.2	148	20	86.5
"	--	--	--	9/3/58	-	-	185	12	93.5	192	10	94.8
"	--	--	--	10/14/58	-	-	181	14.2	92.2	212	23	89.2
"	--	--	--	11/19/58	-	-	144	15	89.6	170	20	88.2
"	--	--	--	12/29/58	-	-	150	19	87.3	250	17	93.2
"	--	--	--	1/28/59	-	-	239	15.1	93.7	280	20	92.9
"	--	--	--	3/25/59	-	-	138.4	10	92.8	126	9	92.9
"	--	--	--	4/28/59	-	-	120	20	83.3	144	20	86.1
"	--	--	--	5/25/59	-	-	197	16.5	91.6	224	36	83.9
"	--	--	--	6/23/59	-	-	212	21.7	89.8	286	37	87.1
"	--	--	--	7/28/59	-	-	143	8.1	94.3	140	30	78.6
"	--	--	--	8/25/59	-	-	282	11.5	95.9	242	16	93.4
"	--	--	--	9/28/59	-	-	350	10.2	97.1	328	17	94.8
"	--	--	--	10/27/59	-	-	192	10.5	94.5	156	10	93.6
"	--	--	--	12/29/59	-	-	221	6.3	97.1	198	20	89.9
"	--	--	--	1/14/60	-	-	120	2	98.3	158	16	89.9
"	--	--	--	2/23/60	-	-	173	13	92.5	112	6	94.6
"	--	--	--	3/30/60	-	-	85.3	10.8	87.3	124	32	74.2
"	--	--	--	4/14/60	-	-	145	12	91.7	210	4	98.1
"	--	--	--	5/18/60	-	-	198	23	88.4	138	41	70.3
"	--	--	--	Ave.	-	-	--	--	92.1	--	--	89.3
"	21	50.0	8.4e	10/14/58	17	8	78	4	94.9	132	55	58.3
"	--	--	--	12/29/58	-	-	154	28	81.8	288	33	88.5
"	--	--	--	1/29/59	-	-	83	8	90.4	158	14	91.1
"	--	--	--	2/24/59	-	-	98	6	93.9	42	10	76.2
"	--	--	--	3/25/59	-	-	61	8	86.9	146	29	80.1
"	--	--	--	4/29/59	-	-	50	8	84.0	48	11	77.1
"	--	--	--	5/26/59	-	-	136	6	95.6	150	10	93.3
"	--	--	--	6/23/59	-	-	164	7	95.7	160	21	86.9
"	--	--	--	7/28/59	-	-	90	4	95.6	140	36	74.3
"	--	--	--	8/25/59	-	-	189	8	95.8	240	32	86.7
"	--	--	--	9/28/59	-	-	152	5	96.7	254	19	92.5
"	--	--	--	10/27/59	-	-	98	4	95.9	224	20	91.1
"	--	--	--	12/29/59	-	-	74	11	85.1	160	64	60.0
"	--	--	--	2/11/60	-	-	62	7	88.7	124	10	91.9
"	--	--	--	3/29/60	-	-	45	11	75.6	140	38	72.9
"	--	--	--	4/27/60	-	-	61	6	90.2	180	42	76.7
"	--	--	--	5/24/60	-	-	198	11	94.4	142	22	84.5
"	--	--	--	Ave.	-	-	--	--	90.7	--	--	81.3
"	22	40.0	42.0e	12/29/59	6	8	132	21	84.1	66	54	18.2
"	--	--	--	1/15/60	-	-	143	17	88.1	210	51	75.7
"	--	--	--	2/23/60	-	-	--	--	--	308	10	96.8
"	--	--	--	3/30/60	-	-	167	23.4	86.0	270	12	95.6
"	--	--	--	4/14/60	-	-	154	16	89.6	230	85	63.0
"	--	--	--	5/18/60	-	-	158	8	94.9	124	38	69.4
"	--	--	--	Ave.	-	-	--	--	88.5	--	--	69.8
"	23	15.0	11.0e	2/24/59	13	8	72.2	7.1	90.2	50	5	90.0
"	--	--	--	3/25/59	-	-	34	4	88.2	60	8	86.7
"	--	--	--	4/29/59	-	-	30	3.8	87.3	30	4	86.7
"	--	--	--	7/28/59	-	-	370	6.1	98.4	220	48	78.2
"	--	--	--	8/25/59	-	-	122	12	90.2	138	17	87.7
"	--	--	--	9/27/59	-	-	62	2.4	96.1	46	3	93.5

(1) Grab Samples

EXTENDED-AERATION PLANTS (Contd.)

Analyses								Sludge Holding Facilities	Comments
Solids - ppm				S. V. I. 1	C. O. D. - ppm				
ML SS 1		Ret. Sludge 1			Raw	Effl.	% Rmvl.		
Tot.	Vol.	Tot.	Vol.						
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-

Type Facility Served	Plant No.	Flow - 1000 gpd		Sampling Period Dates	Composites		Laboratory BOD (5) - ppm			Laboratory Suspended		
		Design	Actual		No.	Duration hrs.	Raw	Effl.	% Rmvl.	Raw	Effl.	% Rmvl.
Housing Development	--	--	--	10/27/59	--	--	156	3	98.1	114	30	73.7
"	--	--	--	12/29/59	--	--	63	6.8	89.2	80	10	87.5
"	--	--	--	2/11/60	--	--	64.7	6.6	89.8	38	5	86.8
"	--	--	--	3/29/60	--	--	64.7	6.6	89.8	312	10	96.8
"	--	--	--	4/27/60	--	--	89	13	85.4	304	34	88.8
"	--	--	--	5/19/60	--	--	55	6	89.1	144	4	97.2
"	--	--	--	6/--/60	--	--	103	4	96.1	198	20	89.9
"	--	--	--	Ave.	--	--	--	--	91.4	--	--	88.0
"	24	48.7	13.2e	1959-60	8	--	219	12	94.5	213	20	90.6
"	--	--	--	1/5/60	37	8	390	30	92.3	160	16	90.0
"	--	--	--	1/8/60	--	--	250	14	94.4	170	26	84.7
"	--	--	--	1/12/60	--	--	470	33	93.0	350	28	92.0
"	--	--	--	1/15/60	--	--	140	19	86.4	120	60	50.0
"	--	--	--	1/19/60	--	--	320	24	92.5	300	33	89.0
"	--	--	--	1/22/60	--	--	220	27	87.7	140	28	80.0
"	--	--	--	1/25/60	--	--	170	10	94.1	180	15	91.7
"	--	--	--	1/29/60	--	--	240	15	93.8	140	18	87.1
"	--	--	--	2/2/60	--	--	420	20	95.2	130	10	92.3
"	--	--	--	2/5/60	--	--	320	27	91.6	150	19	87.3
"	--	--	--	2/9/60	--	--	450	40	91.1	190	29	84.7
"	--	--	--	2/12/60	--	--	340	34	85.8	84	10	88.1
"	--	--	--	2/16/60	--	--	320	19	94.1	140	12	91.4
"	--	--	--	2/19/60	--	--	340	22	93.5	130	13	90.0
"	--	--	--	2/23/60	--	--	470	32	93.2	200	13	93.5
"	--	--	--	2/29/60	--	--	480	42	91.3	140	17	87.9
"	--	--	--	3/8/60	--	--	270	21	92.2	150	22	85.3
"	--	--	--	3/11/60	--	--	180	10	94.4	120	22	81.7
"	--	--	--	3/15/60	--	--	180	18	90.0	110	18	83.6
"	--	--	--	3/18/60	--	--	330	19	94.2	240	10	95.8
"	--	--	--	3/22/60	--	--	420	20	95.2	120	15	87.5
"	--	--	--	3/26/60	--	--	460	25	94.6	140	14	90.0
"	--	--	--	3/29/60	--	--	220	12	94.5	72	14	80.6
"	--	--	--	4/2/60	--	--	450	34	92.4	250	15	94.0
"	--	--	--	4/6/60	--	--	110	67	39.1	160	34	78.8
"	--	--	--	4/9/60	--	--	380	31	91.8	130	21	83.8
"	--	--	--	4/12/60	--	--	480	42	91.3	170	20	88.2
"	--	--	--	4/19/60	--	--	480	40	91.7	140	24	82.9
"	--	--	--	4/23/60	--	--	180	22	87.8	140	27	80.7
"	--	--	--	5/4/60	--	--	430	23	94.7	104	29	72.1
"	--	--	--	5/7/60	--	--	350	13	96.3	120	28	76.7
"	--	--	--	5/10/60	--	--	410	46	88.8	116	25	78.4
"	--	--	--	5/13/60	--	--	380	23	93.9	88	23	73.9
"	--	--	--	5/20/60	--	--	360	15	95.8	116	18	84.5
"	--	--	--	5/24/60	--	--	300	22	92.7	120	19	84.2
"	--	--	--	5/26/60	--	--	330	21	93.6	130	23	82.3
"	--	--	--	5/31/60	--	--	270	18	93.3	150	23	84.7
"	--	--	--	Ave.	--	--	--	--	91.0	--	---	84.6
"	25	50.0	--	7/13-14/57	1	24	130	7.5	94.2	76	117	0
Industry	26	15.0	16.8e	5/5/60	3	9-10	124	30	75.8	56	12	78.6
"	--	--	--	5/21/60	--	--	147	10	93.2	115	tr.	100.0
"	--	--	--	5/26/60	--	--	55	10	81.8	80	0	100.0
"	--	--	--	Ave.	--	--	--	--	83.6	--	--	92.9

(1) Grab Samples

Analyses								Sludge Holding Facilities	Comments
Solids - ppm				S. V. I. $_1$	C. O. D. - ppm				
ML SS$_1$		Ret. Sludge$_1$			Raw	Effl.	% Rmvl.		
Tot.	Vol.	Tot.	Vol.						
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
4600	--	--	--	--	--	--	--	-	
5200	--	8560	--	125	--	--	--	-	Ave. of 8 days; reported by SHD
4450	--	7910	--	148	--	--	--	-	
6200	--	9420	--	118	--	--	--	-	Data rept. by County Hlth. Dept.
5400	--	12000	--	115	--	--	--	-	
4900	--	9200	--	110	--	--	--	-	
3640	--	6830	--	115	--	--	--	-	
4010	--	7440	--	120	--	--	--	-	
3800	--	6840	--	130	--	--	--	-	
3500	--	8400	--	197	--	--	--	-	
3050	--	6800	--	190	--	--	--	-	
3150	--	6750	--	149	--	--	--	-	
2850	--	7000	--	210	--	--	--	-	
3200	--	6200	--	103	--	--	--	-	
2700	--	2500	--	163	--	--	--	-	
3200	--	6200	--	184	--	--	--	-	
3250	--	5900	--	210	--	--	--	-	
2900	--	4900	--	190	--	--	--	-	
2850	--	5020	--	153	--	--	--	-	
2750	--	5600	--	145	--	--	--	-	
3500	--	8400	--	144	--	--	--	-	
3350	--	8700	--	226	--	--	--	-	
3480	--	5900	--	240	--	--	--	-	
3360	--	6300	--	238	--	--	--	-	
3300	--	6780	--	120	--	--	--	-	
150	--	230	--	1300	--	--	--	-	
2100	--	6040	--	170	--	--	--	-	
870	--	980	--	173	--	--	--	-	
2100	--	5700	--	300	--	--	--	-	
2000	--	5700	--	200	--	--	--	-	
2100	--	5600	--	238	--	--	--	-	
2100	--	5500	--	276	--	--	--	-	
1900	--	5400	--	230	--	--	--	-	
1890	--	5400	--	264	--	--	--	-	
1400	--	4900	--	400	--	--	--	-	
1710	--	5000	--	245	--	--	--	-	
1300	--	6000	--	330	--	--	--	-	
2200	--	6400	--	259	--	--	--	-	
2967	--	6281	--	222	--	--	--	-	
2660	400	--	--	--	--	--	--	-	
2390	1700	15260	10220	42	124	30	75. 8	-	Mechanical Aeration
4920	3190	13000	8350	61	147	10	93. 2	-	
2925	1885	16850	15210	--	550	71	87. 1	-	
3411	2258	15036	11260	52	--	--	85. 4	-	

Type Facility Served	Plant No.	Flow - 1000 gpd		Sampling Period Dates	Composites		Laboratory					
							BOD (5) - ppm			Suspended		
		Design	Actual		No.	Duration hrs.	Raw	Effl.	% Rmvl.	Raw	Effl.	% Rmvl.
Industry	27	26.0	8.1e	3/10/60	2	8	375	62	83.5	280	290	0
"	--	--	--	5/12/60	--	--	380	34	91.1	420	40	90.5
"	--	--	--	Ave.	--	--	--	--	87.3	--	--	45.2
"	28	6.9	5.2e	12/12/59	2	8	1400	--	--	470	1580	0
"	--	--	--	2/5/60	--	--	--	--	--	170	15	91.2
"	--	--	--	Ave.	--	--	--	--	--	--	--	45.6
"	29	20.0	--	1/21/60	1	--	2270	280	87.7	670	400	40.3
"	30	100.0	54.6	3/10-11/59	--	--	112	7	93.8	120	70	41.7
"	31	20.0	14.7	3/29/60	1	--	277	--	--	112	9	92.0
"	32	32.7	43.0e	8/12/58	2	8	--	--	--	48	12	75.0
"	--	--	--	8/13/58	--	--	--	--	--	165	20	87.9
"	--	--	--	Ave.	--	--	--	--	--	--	--	81.5
Community	33	15.0	17.3e	3/24/60	2	8	405	97	76.0	250	90	64.0
"	--	--	--	7/13/60	--	--	370	43	88.4	155	35	77.4
"	--	--	--	Ave.	--	--	--	--	82.2	--	--	70.7
"	34	40.0	22.0e	8/21/57	4	--	130	16	87.7	111	32	71.2
"	--	--	--	9/6/57	--	--	175	9	94.9	205	12	94.1
"	--	--	--	9/12/57	--	--	132	7	94.7	104	6	94.2
"	--	--	--	10/3/57	--	--	73	6	91.8	51	1	98.0
"	--	--	--	Ave.	--	--	--	--	92.3	--	--	89.4
"	35	120.0	50.0	5/22/59	2	24	--	37	--	300	80	73.3
"	--	--	--	7/30/59	--	--	171	8	95.3	530	122	77.0
"	--	--	--	Ave.	--	--	--	--	95.3	--	--	75.2
"	36	30.0	8.5	9/12/57	1	24	340	12.6	96.3	620	30	95.2
"	37	60.0	64.6	5/3-4/60	4	24	84.5	8.9	89.5	136	82	39.7
"	--	--	--	5/17-18/60	--	--	25.7	7.7	70.0	92	65	29.3
"	--	--	--	5/31-6/1/60	--	--	47.2	5.6	88.1	136	48	64.7
"	--	--	--	6/30-7/1/60	--	--	59.9	16.6	72.3	208	66	68.3
"	--	--	--	Ave.	--	--	--	--	80.0	--	--	50.5
Institution	38	31.0	25.0	6/11/59	1	4	284	8.7	96.9	145	20	86.2
"	39	7.0	9.0e	8/11/58	13	8	444	13	97.1	314	29	90.8
"	--	--	--	8/12/58	--	--	665	15	97.7	553	41	92.6
"	--	--	--	8/13/58	--	--	385	15	96.1	342	68	80.1
"	--	--	--	8/14/58	--	--	465	29	93.8	258	39	84.9
"	--	--	--	8/15/58	--	--	2670	40	98.5	1336	143	89.3
"	--	--	--	1959	--	--	237	25	89.5	138	18	87.0
"	--	--	--	1959	--	--	1040	25	97.6	539	16	97.0
"	--	--	--	1959	--	--	220	27	87.7	207	6	97.1
"	--	--	--	1959	--	--	150	35	76.7	23	31	0.0
"	--	--	--	1960	--	--	1360	59	95.7	637	65	89.8
"	--	--	--	1960	--	--	1480	21	98.6	870	45	94.8
"	--	--	--	1960	--	--	1500	11	99.3	363	6	98.3
"	--	--	--	1960	--	--	299	16	94.6	220	6	97.3
"	--	--	--	Ave.	--	--	--	--	94.1	--	--	84.5
"	40	40.0	26.5	8/14-15/58	1	24	130	9	93.1	242	51	78.9
Tourist Facility	41	25.0	38.0e	4/20/60	6	8	460	50	89.1	208	59	71.6
"	--	--	--	4/27/60	--	--	370	500	0	207	1662	0
"	--	--	--	4/28/60	--	--	640	510	20.3	322	980	0
"	--	--	--	5/3/60	--	--	980	405	58.7	700	632	9.7
"	--	--	--	5/4/60	--	--	740	420	43.2	894	480	46.3
"	--	--	--	5/5/60	--	--	430	325	24.4	75	484	0

(1) Grab Samples

EXTENDED-AERATION PLANTS (Contd.)

Analyses									
Solids - ppm				S. V. I. $_1$	C. O. D. - ppm			Sludge Holding Facilities	Comments
ML SS$_1$		Ret. Sludge$_1$			Raw	Effl.	% Rmvl.		
Tot.	Vol.	Tot.	Vol.						
1400	1100	2400	1970	172	850	190	77.6	-	
3160	2630	4880	4050	70	865	150	82.7	-	
2280	1865	3680	3010	121	--	--	80.1	-	
1880	1480	1780	1380	516	3150	3330	0	-	"Raw has distinct odor of soap
1930	1760	30	30	130	2430	45	98.1	-	and disinfectant."
1905	1620	925	725	323	--	--	49.1	-	
9280	8830	9160	8170	99	4100	2050	50.0	-	
5500	--	--	--	--	--	--	--	Yes	
1600	1030	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	Yes	
--	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
3400	2740	4130	3450	167	520	270	48.1	-	
4110	3395	4375	3575	41	610	180	70.5	-	
3755	3068	4253	3513	104	--	--	59.3	-	
--	--	--	--	--	--	--	--	-	
2120	--	--	--	--	--	--	--	-	
2860	--	--	--	--	--	--	--	-	
4750	--	--	--	--	--	--	--	-	
3243	--	--	--	--	--	--	--	-	
2920	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
2920	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
960	--	--	--	--	--	--	--	No	
1170	400	--	--	--	--	--	--	Yes	4 grab samples (1 ea. day) of
2270	840	--	--	--	--	--	--	-	the effluent indicate an ave.
3590	1390	--	--	--	--	--	--	-	MPN of 4.0×10^5.
2000	880	--	--	--	--	--	--	-	Effluent contained from 3.5 to
									16.5 ppm chromium.
780	--	--	--	--	--	--	--	Yes	Mechanical Aeration
--	--	--	--	--	--	--	--	Yes	
--	--	--	--	--	--	--	--	-	
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3144	--	--	--	63	--	--	--	-	
1784	--	--	--	90	--	--	--	-	
2560	--	--	--	85	--	--	--	-	
2732	--	--	--	65	--	--	--	-	
--	--	--	--	--	--	--	--	-	
8672	--	--	--	--	--	--	--	-	
9200	--	--	--	--	--	--	--	-	
8556	--	--	--	--	--	--	--	-	
5235	--	--	--	76	--	--	--	-	
3005	--	--	--	--	--	--	--	Yes	
--	--	--	--	--	--	--	--	Yes	
2040	--	--	--	--	--	--	--	-	
1540	--	--	--	--	--	--	--	-	
1248	--	--	--	--	--	--	--	-	
912	--	--	--	--	--	--	--	-	
608	--	--	--	--	--	--	--	-	

Type Facility Served	Plant No.	Flow - 1000 gpd Design	Flow - 1000 gpd Actual	Sampling Period Dates	Composites No.	Composites Duration hrs	BOD (5) - ppm Raw	BOD (5) - ppm Effl.	BOD (5) - ppm % Rmvl.	Laboratory Suspended Raw	Laboratory Suspended Effl.	Laboratory Suspended % Rmvl.
Tourist	--	--	--	Ave.	--	--	--	--	39.3	--	--	21.3
Facility	42	2.5	1.9	6/9/60	2	8	1270	220	82.7	540	365	32.4
"	--	--	--	7/16/60	--	--	1700	540	68.2	565	560	0
"	--	--	--	Ave.	--	--	--	--	75.5	--	--	16.2
"	43	20.0	--	6/5/59	6	8	615	148	75.9	240	146	39.2
"	--	--	--	10/18/59	--	--	--	150	--	--	74	--
"	--	--	--	10/19/59	--	--	480	299	37.7	244	167	31.6
"	--	--	--	4/27/60	--	--	223	46	79.4	241	51	78.8
"	--	--	--	6/7/60	--	--	300	50	83.3	147	49	66.7
"	--	--	--	6/9/60	--	--	440	47	89.3	182	74	59.3
"	--	--	--	Ave.	--	--	--	--	73.1	--	--	55.1
"	44	8.5	5.1	6/14-15/54	2	24	248	31	87.5	270	174	35.6
"	--	--	--	10/30-31/57	--	--	250	31	87.6	210	135	35.7
"	--	--	--	Ave.	--	--	--	--	87.5	--	--	35.6
"	45	25.0	--	3/11/59	1	5	275	22	92.0	256	69	78.0
"	46	15.0	5.8	2/16/60	1	11	320	57	82.2	250	59	73.0
Shopping	47	38.4	55.9	1959-60	10	--	109	8.7	92.0	49	64	0
Center	48	23.0	11.0e	7/17/58	3	3-6.5	142	20	85.9	120	30	75.0
"	--	--	--	8/26/58	--	--	1440	12	99.2	7300	50	99.3
"	--	--	--	6/2/59	--	--	300	13	95.7	280	30	89.3
"	--	--	--	Ave.	--	--	--	--	93.6	--	--	87.9
"	49	15.0	14.6	6/25-26/58	1	24	400	26	93.5	560	270	51.8
"	50	12.0	14.7e	2/25/58	4	10	500	54	89.2	288	172	40.3
"	--	--	--	2/26/58	--	--	530	80	84.9	266	204	23.3
"	--	--	--	6/10/58	--	--	680	104	84.7	312	135	56.7
"	--	--	--	6/11/58	--	--	520	46	91.2	280	142	49.3
"	--	--	--	Ave.	--	--	--	--	87.5	--	--	42.4
"	51	40.0	33.0	5/5/59	14	6-12	70	8	88.6	48	16	66.7
"	--	--	--	6/1/59	--	--	87	5	94.3	152	16	89.5
"	--	--	--	7/9/59	--	--	78	3	96.2	196	20	89.8
"	--	--	--	8/13/59	--	--	223	4	98.2	184	14	92.4
"	--	--	--	9/3/59	--	--	210	3	98.6	86	16	81.4
"	--	--	--	10/8/59	--	--	192	6	96.9	74	26	64.9
"	--	--	--	11/2/59	--	--	194	5	97.4	80	30	62.5
"	--	--	--	12/2/59	--	--	120	2	98.3	68	4	94.1
"	--	--	--	1/6/60	--	--	110	5	95.5	40	6	85.0
"	--	--	--	2/4/60	--	--	65	4	93.8	30	10	66.7
"	--	--	--	3/2/60	--	--	161	4	97.5	182	26	85.7
"	--	--	--	4/4/60	--	--	167	5	97.0	94	44	53.2
"	--	--	--	5/12/60	--	--	213	6	97.2	172	48	72.1
"	--	--	--	5/13/60	--	--	195	4	97.9	154	26	83.1
"	--	--	--	Ave.	--	--	--	--	96.2	--	--	77.7
"	52	60.0	12.0	5/3/60	2	6	223	4	98.2	182	1	99.5
"	--	--	--	5/20/60	--	--	280	5	98.2	276	20	92.8
"	--	--	--	Ave.	--	--	--	--	98.2	--	--	96.2
"	53	100.0	42e	4/8/60	6	8-12	595	49	91.8	400	2	99.5
"	--	--	--	4/9/60	--	--	702	23	96.7	240	16	93.3
"	--	--	--	4/10/60	--	--	717	12	98.3	504	60	88.1
"	--	--	--	4/25/60	--	--	303	8	97.4	220	3	98.6
"	--	--	--	4/26/60	--	--	333	7	97.9	322	1	99.7
"	--	--	--	5/29/60	--	--	686	28	95.9	--	--	--
"	--	--	--	Ave.	--	--	--	--	96.3	--	--	95.8
"	54	30.0	20.0	5/6/59	1	8	889	50	94.4	164	40	75.6

(1) Grab Samples

EXTENDED-AERATION PLANTS (Contd.)

Analyses								Sludge Holding Facilities	Comments
Solids - ppm				S. V. I. $_1$	C. O. D. - ppm				
ML SS$_1$		Ret. Sludge$_1$			Raw	Effl.	% Rmvl.		
Tot.	Vol.	Tot.	Vol.						
1270	--	--	--	--	--	--	--	-	
335	300	--	--	--	2440	450	81.6	-	
615	560	--	--	--	2340	995	57.5	-	
475	430	--	--	--	--	--	69.6	-	
--	--	--	--	--	--	--	--	No	Mechanical Aeration
--	--	--	--	--	--	--	--	-	
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--	--	--	--	--	--	--	--	No	
5985	2755	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
2790	--	--	--	161	--	--	--	Yes	
6440	5368	--	--	--	--	--	--	Yes	Mechanical Aeration
6877	--	--	--	--	--	--	--	-	Data are ave. of 10 days
--	--	--	--	--	--	--	--	Yes	
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8600	--	--	--	--	--	--	--	-	
--	--	--	--	--	--	--	--	-	
10525	4160	--	--	--	--	--	--	Yes	Mechanical Aeration
--	--	--	--	--	--	--	--	Yes	
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Type Facility Served	Plant No.	Flow - 1000 gpd		Sampling Period Dates	Composites		Laboratory BOD (5) - ppm			Laboratory Suspended		
		Design	Actual		No.	Duration hrs.	Raw	Effl.	% Rmvl.	Raw	Effl.	% Rmvl.
Misc.	55	8.5	3.3e	11/28/59	3	--	800	6	99.3	320	4	98.8
"	--	--	--	1/9/60	--	--	700	20	97.1	244	6	97.5
"	--	--	--	4/7/60	--	--	1890	50	97.4	580	40	93.1
"	--	--	--	Ave.	--	--	--	--	97.9	--	--	96.5
"	56	13.5	3.3e	11/21/59	3	9	160	54	66.3	104	64	38.5
"	--	--	--	3/31/60	--	--	106	26	75.5	170	40	76.5
"	--	--	--	7/29/60	--	--	235	19	91.9	285	30	89.5
"	--	--	--	Ave.	--	--	--	--	77.9	--	--	68.2
"	57	8.5	--	1/29/60	1	--	290	120	58.6	130	80	38.5
"	58	8.5	--	2/25/60	1	--	775	305	60.6	240	210	12.5
"	59	21.4	--	2/18/60	1	--	405	70	82.7	72	148	0

(1) Grab Samples

EXTENDED-AERATION PLANTS (Contd.)

Analyses								Sludge Holding Facilities	Comments
Solids - ppm				S. V. I. $_1$	C. O. D. - ppm				
ML SS$_1$		Ret. Sludge$_1$			Raw	Effl.	% Rmvl.		
Tot.	Vol.	Tot.	Vol.						
5170	4040	5490	4300	174	1390	0	100.0	No	
7760	6410	8100	6660	128	830	72	91.3	-	
2860	2430	3390	2890	346	2660	116	95.6	-	
5263	4293	5660	4616	216	--	--	95.6	-	
2280	2010	2120	1890	118	490	235	52.0	-	
2780	2560	3320	3040	340	302	189	37.4	-	
3840	3420	3910	3560	--	960	156	83.8	-	
2967	2663	3117	2830	229	--	--	57.7	-	
1440	1170	1360	1090	95	530	330	37.7	-	
980	805	1115	795	56	--	390	--	-	
7285	5575	7225	5295	82	725	350	51.7	-	

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APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Ala.	Comm. reqd.	24-hr. aeration max. BOD load of 30#/day/1000 cu. ft. a) diffused air-(air) min. of 1500 ft^3/day/#BOD. b) Mech. aerators min. of 500 ft^3/day/#BOD.	4-hrs. det with max. settl. rate of 700 gals. per ft^2/day & max. weir loading of 6000 gals. per ft. per day.		In most cases the state asks that chlorination be incld. Requirement is dependent upon use of receiving water.		Are reviewing present design criteria. "While length of our experience with aerobic digestion plants is limited to approx. 2 yrs. we have been impressed with the performance of units installed in Ala. & consider the process as providing acceptable secondary treatment of sewage."
Col.	None specifically for extended aeration plants, follows plans & specifications as required for conventional sewage treatment works. (SEC)				"Disinfecting needed to meet coliform requirements."	"Recommend oxidation ponds following to 'even out' effluent quality. Further exp. may result in dropping this requirement."	
Fla.	Accept manufacturers recommendations & require surety bond if unfamiliar with process.			Require sludge holding tanks.	Require effluent chlorination.		
Ill.		Defoaming surface spray equipment requested where necessary or desirable. The state legal requirements are those contained in the	Flow meas. provisions usually of the V-notch weir-type-requested where necessary or desirable.	Sludge storage capacity of 2 ft^3 per cap. requested where necessary or desirable.	Requested where necessary or desirable.	"In some areas, an effluent lagoon has been specified. as tertiary treatment"--requested where necessary or desirable.	Not many of the units in Ill. have been in operation long enough to form very positive opinions regarding operation problems or efficiencies. Most units are grossly underloaded

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Ill. (Contd.)		rules & regulations for treatment works & are almost identical to the Ten State Std's. A few additional items have been specified for individual manufactured products or for special locations.					with the result that relatively clear effluents result.
Ind.					May be required at some installations.	Sand filters may be required at some installations.	"It is the policy of this board to tailor treatment requirements to individual locations with consideration being given to adjacent downstream water uses, installations, & dilution water available. In general it has been noted that aerobic digestion plants have provided adequate treatment where the owner has shown an interest in proper operation & maintenance. Without routine care, the results are not satisfactory."
Iowa	State of Ohio Standards					Either stab. pond or sand filter should	"Plants of this type will be approved where receiving

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Iowa (Contd.)						follow the treat. plant where stream flow is not adequate--req'd.	stream has adequate flow for dilution or where downstream use will not be affected."
Ky.	Comm. necc.	24-hr. aeration	2. 5-4 hrs. detention	Sludge balancing tank reqd. over 25000-50000 gpd plant size. 3 ft.^{3} per cap	If determined to be necessary.		"Mechanical aeration caused difficulty because of lack of flexibility, to supply or increase air as load changes (subdivision day night & expansion by new homes.) No method to measure air being supplied. All plants which have capacities above 25,000 gpd where a high degree of treatment is needed, need sludge balancing tank."
Minn.	Comm. reqd.	Tank capacity should not be less than daily flow of sewage or waste. The BOD loading should not be greater than 25 lbs/1000 ft^3 of aeration tank capacity/day. No legal reqmts. or fixed policy estab. by regul. has been made.					"An excessive carry-over of finely divided AS floc has been noted at some of the installations where the sewage flow is concd. during a 6-8 hr. period. This may indicate the need for larger secondary settling chambers or tanks to provide longer (3-4 hrs) detention time during the period of the day

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Minn. (Contd.)							when the flow of sewage is concd."
Mo.						Sand filter required--loaded at 1 mgad.	"We consider these units as experimental; we estimate BOD & SS at approximately 70%."
Ohio	Recom for all installations; required for plants of 40,000 gpd or more. Bar screens, trash traps, & screening baskets acceptable on smaller plants (required in lieu of comminution).	For plants of 40,000 gpd or more, at least two aeration tanks and two settlers are required. 24-hrs detention reqd. at avg. daily sewage flow (not incl. recirculation). -2100 ft^3 air/lb BOD or 3 cfm/ft. tank length (whichever is greater) for aeration alone (air lift reqd. not incl.) For plants of 20,000 gpd or more, sufficient blower capacity must be supplied to meet air req. with the largest single blower out of service.	4-hrs. detention for avg. daily sewage flow (not incl. recirculalation) for hopper bottomed tanks, upper 1/3 of depth of hopper considered as effective settling capacity--Positive sludge return. (Pumping or air lift) required at a min rate of 1 to 1.	4-8 cu. ft/cap are recomm. for all plants where aeration is accomplished by mech. means.	Required where necessary		Recording devices (V-notch weir or other) reqd. for larger installations (40,000 gpd & larger). Require a fence around plant, high enough to discourage trespassers & far enough from the tanks so it is not easy to throw articles into tanks. Tanks req. to be at least 250' from nearest dwelling. "These plants are generally lower in first cost than other plants producing comparable results. However the operating cost of aerobic digestion plants are high. Daily attention must be given to these plants. Troubles are: clogging of air lift pumps, grease balls in aeration tank & scum on settlers.

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Okla	Same requirements and criteria as for other types of sewage treatment processes.					Stab. Pond must follow treatment plants.	"Generally satisfactory for small installations. Slightly higher level of operation & maintenance required. In general, cannot meet state requirements for degree of treatment, therefore, the requirement of a lagoon following the plant."
Oreg.	Comminutor required		Require positive scum skimming on final clarifier		Effluent chlorination required		"Have had trouble with final settling in aerobic digestion plants, particularly with grease balls in effluent."
Pa	Comminutor with bar screen required for all installations.	Single aeration tanks operating more than 120 days/yr. shall be limited to a volume of 5,000 ft^3-37,400 gals. Reqmt. of 30 hr. detention at avg. daily flow without regard to recirculation. Air blowers unit reqd. (one) 1) two blowers, ea. capable of supplying 3,500 ft^3/lb BOD.	2-1/2 hr. detention period based on avg. flow during run-off period without regard to recirculation. For hopper bottomed tanks, the upper 1/3 of the hopper depth may be incld. in calculating capacity. The surface settling rate shall not be more than 600 gpd per ft^2 in any installation & in smaller installations should be as low as 350 gpd per ft^2.				State of Pa. Sewerage Manual. "These plants are doing a relatively good job-- 1 hr/day ± essential for proper operation & maintenance (of laborer). Everytime our men get around everything is ok--. Recommended at least 250' from dwellings. A V-notch weir or other appropriate device should be installed in larger installations."

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Pa. (Contd.)		2) two blowers, ea. capable of supplying 1,750 ft^3/lb BOD, with space & provision to install a third unit. 3) 3 blowers, ea. capable of supplying 1,200 ft^3/lb BOD. Additional air capacity required for air lifts et. al. Air diffusers of the type that can be raised for inspection & replacement in a min. of time without dewatering the tank. They should be located 1' above tank bottom when in operating position. Above reqmts. are for diffused air type equipm. Mech. aer. equipm. will only be consided-ed upon submission of acceptable data indicating equipm. efficiency.	Surface settling rates are calculated on avg. flow during run-off period. Mechanically cleaned tanks shall be provided in duplicate. Return sludge capacity of at least 150% of the daily flow rate shall be provided. When a sludge pump is used, a spare unit shall be provided.				
Tenn.	Comm. reqd.	24-hr. Detention at mean daily flow.	4-hr. Detention at mean daily flow		Required in almost all cases 45-min. for Cl_2 contact.		Plant area must be fenced, usually with a climb-proof cyclone type fence. "We req. that the plant be owned & operated by a municipality, utility district, a corporation with a charger from the Tenn. Publ. Serv.

APPENDIX B-1. STATE POLICIES & COMMENTS
(States with Individual Design Criteria)

State	Comminutor & Screen.	Aeration Basin	Settling Tank	Sludge Tank	Chlorination	Stab. Ponds & Sand Filters	Comments
Tenn. (Contd.)							Comm. a school board, a recognized industry, or other fully responsible agency."
Wisc.	Ohio Standards used as a guide			Sludge storage tank reqd. for all plants- min. of 6 cu. ft. per cap. for unheated tanks.			So far, no sludge has been unloaded or hauled away from the plants having sludge holding tanks. The limit amt. of capital a community can raise sometimes makes it a necessity to go to small package plants because of first cost. "Wisc. requires that any treatment plant serving a residental area be owned & operated by a governmental unit. Private ownership of a STP serving a private institution or business is recognized. The state will approve an individual plan for a treatment plant to serve a residential area with the understanding that it will be turned over to a sanitary district."

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APPENDIX B-2. STATE POLICIES & COMMENTS
(States without Individual Design Criteria)

State	General Requirements	Comments
Alaska	Pacific N. W. WPC Council Standards, adopted in Alaska Administrative Code.	Should solve some cold weather operation problems; approve plants on an experimental basis.
Ariz.	Ohio State Department of Health Requirements	"Plants have not been in operation long enough to properly evaluate results."
Ark.	Rules & regulations require approval of plans & specifications as a public sewage treatment works.	Are accepting a few under experimental basis with guarantee by manufacturer for performance.
Calif.	Vary with Regional WPC Boards which set discharge requirements.	
Conn.		"STP of any kind for housing developments not approved unless operated by the city or town; only one of 3 plants operating satisfactorily after much time & effort on part of state officials and manufacturers."
Del.	Using Ohio criteria for reference	
Ga.		Letter of Reg. IV: "The Administrators of the Ga. Water & Sewage Program in the past have shied away from these small AS plants, since, as they indicate, they felt a more qualified operator was necessary & as a consequence they have shown some preference for the small TF facility."
Hawaii	Similar to State of Ohio	"We believe that this type of plant will meet many of our problems of sewage disposal in Hawaii."
Idaho	Design must follow sewage works design standards compiled by Pollution Control Council, Pacific Northwest Area.	"In terms of producing a good effluent, our experience with this type plant has been excellent."
Kan.		State comment was that they doubted plants of this type would have same life as conventional plants. Reg. VI
La.	No published design data. Louisiana State Sanitary code requirements are general in nature.	"Generally these plants have been functioning well from all appearances & limited tests. We have had trouble with one serving an elite motel with a heavy catering & party business because of the grease load. We

APPENDIX B-2. STATE POLICIES & COMMENTS
(States without Individual Design Criteria)

State	General Requirements	Comments
La. (Contd.)		think these plants serve a specific need & though not relatively economical to operate are much easier to operate than conventional package type AS. Package type conventional plants or an AS conventional plants continue to be difficult to operate."
Maine		
Md.	No criteria-consider each project on its own merits.	
Mass.	Use as a basis of design - "small activated sludge plants for normal domestic sewage."	All plants must be reviewed & approved by SHD. No discharge to dry streams - These plants are acceptable.
Mich.		Experimental plant is under study for development of criteria & design policy for approval.
Miss.	Accept manufacturers design criteria	More skilled operation is needed.
Mont.	Minimum treatment for domestic sewage is primary treatment plus adeqaute disinfection or sewage lagoon treatment. Higher treatment where needed.	"Question advisability of further installation of this type, since we now have sewage lagoons."
Neb.	Review of plans & specifications made with use of minimum standards as set forth by WPC Board, State of Missouri.	This type of plant is proving very satisfactory in Neb. - very desirable for areas, particularly small communities & where lagoon cannot be used. Plants appear to require a minimum of operation & maintenance similar to small lift station.
Nev.	Upper Mississippi Board of Public Health Engineers & Great Lakes Board of Public Health Engineers Standards for sewage works.	
N. H.		
N. J.	Specific design data only on contact aeration.	Are in favor of, & pressing for more small plants definitely superior to numerous overflowing septic tanks. Operational problem due to lack of proper

APPENDIX B-2. STATE POLICIES & COMMENTS
(States without Individual Design Criteria)

State	General Requirements	Comments
N. J. (Contd.)		maintenance is more significant than design deficiency. Not satisfied at all with certain plants but do not have data or studies to back up suspicions.
N. M.		"Small AS or aeration plants are not recommended for construction in N. M. Not generally considered feasible for populations of 2, 500 or less, due to cost consideration. In many states, the urban sprawl of large cities has resulted in the construction of "neighborhood" treatment plants that discharge effluent from one community's back door into the front yard of the next. State-wide master planning is needed to eliminate the need for many small plants & to provide for a few larger, well run plants."
N. Y.	None of own, using Homer Knox's (Ohio SHD) criteria until state can develop own.	
N. C.		"The State has permitted installation of package plants, particularly in areas where septic tanks are a problem & subdivisions are developing rapidly. To date they are impressed with the absence of odors & the effectiveness of treatment. By keeping these plants under careful observation, they are attempting to gain additional experience on which to base specific criteria & recommendations." Region III
N. D.	These plants would probably be considered under the same basis as the comparable conventional built plants. It would be necessary to obtain treatment results from plants already constructed treating similar wastes. Operational data & costs would also be required.	
R. I.	Review & authorization of State Health Department.	"The State San. Engr. thinks pretty well of these plants." Region II
S. C.	State Board of Health regulations, WPC law & regulations.	These plants do quite well.

APPENDIX B-2. STATE POLICIES & COMMENTS
(States without Individual Design Criteria)

State	General Requirements	Comments
S. D.	Proposed installations are reviewed on an individual basis in accordance with current available information.	Operational reqmts. & high power cost must be carefully considered; use of this type of plant is not encouraged unless no other suitable alternative is apparent.
Tex.	"Experimental approval of sewage treatment process an agreement." (General)	"For the small package plants that have design features not within the recognized limits in our bulletin, we require the execution of the experimental agreement form. Require effluent with max. of 16 ppm of SS & BOD under "Experimental Approval of Sewage Treatment An Agreement" (as determined by 24-hr. composit).
Utah		"It appears from our very limited experience that these plants can only be considered to provide intermediate treatment."
Vt.		
Va.	Ohio Standards & manufacturers data	
Wash.	No formal criteria	Tentative policy-equivalent to intermediate treatment advantages-minimum maintenance.
W. Va.		"Most operate satisfactorily. Operation & proper maintenance may be beyond the capabilities of very small towns."
Wyo.		

APPENDIX C

DATA COLLECTION OUTLINE

SMALL SEWAGE TREATMENT PLANT STUDY

State: _____

*Number of activated sludge package plants in operation or under construction July 1, 1960 treating a load of 2,500 population equivalent or less:

Type Facility Served	Number
Communities	_____
Housing Developments	_____
Shopping Centers	_____
Tourist Courts, Motel, Trailer Parks, etc.	_____
Institutions	_____
Schools	_____
Industries	_____
Others	_____
Total	_____

Number of plants with operating and maintenance data (attach available data and laboratory analyses);

State legal requirements - criteria and policy:

Observations and recommendations of State sanitary engineers:

Name: _____

*Several plants located at one site shall be considered as one plant.

APPENDIX D

FIELD DATA COLLECTION
SMALL SEWAGE TREATMENT PLANTS

State _____ City _____ Date _____

Plant Location _____ Owner _____ Investigator _____

Year plant put in operation _____ Source of information _____

A. AREAL CHARACTERISTICS

1. Distance to nearest home _____ Public sewerage _____
2. Population-homes served: Originally _____ Present _____ Future _____
3. List non-residential contributors _____

   Est. flow, gpd _____ Pop. equiv (BOD) _____
4. Has service area been expanded? _____ When? _____

B. PLANT OPERATION

1. Design flow, gpd. _____ Pop Equiv. (BOD) _____
2. Present flow, gpd. min. _____ Avg. _____ Max. _____
3. Personnel attending plant; number _____ Man-hours per week _____

   Qualifications: _____
4. Regulatory agency _____ : Inspection frequency _____
5. Laboratory facilities _____

   (a) Tests for which equipment is provided _____

   (b) Tests routinely performed _____ Frequency _____

   (c) 5-day BOD; raw sewage _____ Final Effl. _____ % red. _____

   (d) Suspended solids; raw sewage _____ Final Effl. _____ % red. _____

   (e) Setteable solids; raw sewage _____ Final Effl. _____ % red. _____

   (f) Methylene blue stability of effl. (unchlorinated) _____ days.
6. Aerator susp. solids ____ ppm; settled solids ____ ml; SVI _____
7. Sludge holding tank provided _____ Sludge disposal method _____
8. Chlorine; dosage ____ ppm; residual ____ ppm; contact time ____ min.

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FIELD DATA COLLECTION
SMALL SEWAGE TREATMENT PLANTS

9. Operation and general cleanliness of plant; defects, shortcomings, presence of odors, etc.

_____

_____

10. Have there been complaints on plant ?_____Season _____ Number_____.

Describe action taken and results_____

_____

11. Is plant suitable for future sampling in regard to acess, flow measuremsnts, etc. _____

_____

C. INFORMATION ON STREAM OR DILUTING BODY USED FOR DISPOSAL

1. Name of stream _____.
2. Stream flow: dry weather_____c. f. s. ; wet weather _____c. f. s.
3. General appearance and condition of stream (DO)_____

_____.
4. Downstream uses _____

D. COSTS

1. Original - land _____ equipment _____

plant _____ sewers _____

2. Operating (annual) - power utilities _____

Chemicals _____

(List chemicals used) _____

Repairs, replacements _____

Personnel _____

Depreciation (basis) _____

3. Revenue - Basis of charges _____

Mo. charge/residence served _____

FIELD DATA COLLECTION
SMALL SEWAGE TREATMENT PLANTS

4. List pertinent history of plants and plans for eventual termination.

   If no longer used, give time in use, salvage value, other pertinent comments: _____

   _____

   _____

E. GENERAL

Attach the following material separately:

1. Plant flow diagram, with notations as to size and capacity and equipment manufacturer.
2. Laboratory analysis.
3. Additional information for which space above is inadequate, or special conditions not covered in above outline.